Chemical & Engineering NEWS

Engineering plastics set for renewed growth Page 23

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Chemical & Engineering NEWS

Cover: Workman adjusts valve at Houston Natural Gas Corp.'s HNG Petrochemicals facility at Sonora, Tex., which recently was expanded to 60 million cu-ft-per-day capacity

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PLASTICS, FIBERS FINISH YEAR IN TROUBLE

Everyone expected 1981 to be a time of turnaround for plastics and fibers, the two main branches of commercial polymers. But the year was actually a time of turndown. And it doesn't look like things will get better soon. Business conditions during the winter can be called poor and poorer.

Overall, 1981 was not good for plastics and was especially poor for fibers. The final three months were markedly bad for both as fresh data attest.

For all of 1981, plastics shipments increased just 3.2% from 1980 to 27.9 billion lb, according to data published by the Committee on Resin Statistics of the Society of the Plastics Industry. This followed a drop in 1980 of 9% from 1979's 29.8 billion lb. These figures exclude phenolic resins. The SPI changed its reporting base for phenolics last year, putting them on a gross-weight, rather than a dry-weight, basis as they had been in the past. Thus, the figures for phenolics between 1980 and 1981 are not comparable and if they are included with the other plastics, it throws those figures off. The data are gathered for SPI by the New York City accounting firm Ernst & Whinney.

Shipments of thermoset resins, excluding phenolics, increased just 1.9% in 1981 to 2.62 billion lb. Shipments in 1980 had been down 15% from 1979 levels.

The five major thermoplastics—low-density and high-density polyethylene, polypropylene, polystyrene, and polyvinyl chloride—performed better last year than did thermosets, but still they managed only a 3.2% increase from the year before. Shipments of the five major thermoplastics totaled 25.32 billion lb in 1981 compared with 24.50 billion lb in 1980. Shipments in 1980 were 8.4% below 1979 shipments figures of 29.77 billion lb.

Fiber shipments in 1981 dipped slightly below 1980 levels. For man-made fibers, shipments last year amounted to 8.62 billion lb, a drop of 1.4% from 1980. Shipments in 1980 had been down 5.7% from 1979's 9.27 billion lb.

The cellulosics—rayon and acetate—were the worst performers in 1981. Total cellulosic shipments reached almost 718 million lb, falling 4.7% from 1980. Shipments in 1980 had been 12.6% below 1979.

Noncellulosic shipments dropped 1.1% to 7.90 billion lb in 1981; shipments the previous year had been 5.0% below 1979 levels.

However, if the full year was bad, the final quarter of 1981 was abysmal for polymers. Shipments of plastics dropped 11.4% from fourth-quarter 1980 to 6.48 billion lb. And man-made fiber shipments dropped even more, 17.1% to 1.94 billion lb.

Of the plastics, thermosets, again excluding phenolics, were worse off. Thermoset shipments in the fourth quarter dropped 16.0% from a year earlier to about 556 million lb.

The five major thermoplastics, however, also did not have things going their way. Shipments for these big-volume products dropped 10.9% in the quarter to 5.92 billion lb. The biggest loser of the thermoplastics was polyvinyl chloride, shipments of which fell 20.2% to 1.16 billion lb in the quarter.

In fibers, unlike the year as a whole, it was the noncellulosics that had the largest drop in the last three months of 1981. The cellulosics dropped 9.4% to 161 million lb. Rayon shipments held almost flat at about 108 million lb in the quarter, just 1.6% below shipments in fourth-quarter 1980. In the cellulosics, it was acetate that took a dive in the fourth quarter. Acetate shipments dropped 22.1% to 53.1 million lb.

However, noncellulosic shipments, led by nylon, fell 17.8% in the fourth quarter to 1.78 billion lb. Nylon shipments in the fourth quarter plummeted 35.5% to 446 million lb. This drop was largely because of poor construction markets affecting nylon going into carpets. Nylon carpet filament shipments in the fourth quarter dropped to 123 million lb. And nylon staple fell 44.9% to about 126 million lb.

Unfortunately, the worst is not

Polymer shipments edged up slightly in 1981

Shipments, millions of lb	1981	1980	1979	% change 1980–81	% change 1979–80
PLASTICS					
Thermosets[a]	**2,624.6**	**2,576.4**	**3,030.6**	**1.9%**	**−15.0%**
Epoxy	332.1	318.8	332.0	4.2	−4.0
Polyester	976.0	944.4	1,151.6	3.3	−18.0
Urea	1,139.9	1,147.3	1,355 3	−0.6	−15.3
Melamine	176.6	165.9	191.8	6.4	−13.5
Phenolic[b]	2,386.7	1,516.6	1,731.9	nc	−12.4
Thermoplastics	**25,324.4**	**24,500.0**	**26,737.4**	**3.4**	**−8.4**
Low-density polyethylene	7,516.4	7,467.5	7,814.8	0.7	−4.4
High-density polyethylene	4,682.8	4,393.6	4,893.2	6.6	−10.2
Polypropylene	3,891.0	3,714.5	3,894.3	4.8	−4.6
Polyvinyl chloride	5,631.7	5,407.2	6,137.9	4.2	−11.9
Polystyrene	3,602.5	3,518.0	3,997.2	2.4	−12.0
TOTAL PLASTICS[a]	**27,949.0**	**27,076.4**	**29,768.0**	**3.2%**	**−9.0%**
FIBERS					
Cellulosic	**717.8**	**753.6**	**861.7**	**−4.7**	**−12.6**
Rayon	456.7	451.7	542.5	1.1	−16.7
Acetate	261.1	301.9	320.2	−13.5	−5.7
Noncellulosic	**7,898.2**	**7,988.1**	**8,406.6**	**−1.1**	**−5.0**
Polyester	4,168.8	4,035.9	4,146.1	3.3	−2.8
Nylon	2,254.8	2,430.0	2,722.2	−7.2	−10.7
Acrylic	694.5	771.1	770.2	−9.9	0.1
Olefin	780.1	751.1	768.1	3.9	−2.2
TOTAL FIBERS	**8,616.0**	**8,741.7**	**9,269.3**	**−1.4%**	**−5.7%**
TOTAL POLYMERS[a]	**36,565.0**	**35,818.1**	**39,037.3**	**2.1%**	**−8.2%**

a Totals excluding phenolic resins. b 1981 shipments are on a gross weight basis, previous years are on a dry weight basis. nc = no change.

over for producers of fibers and of plastics. Observers in both industries say that January has not shown any signs of increased momentum. Plastics producers seem especially pessimistic as demand for the leading thermoplastics continues to fall. And for the full year, most are not expecting any great increase over 1981. □

High-protein rice developed at USDA

Using plant tissue culture techniques, researchers at the Department of Agriculture's Agricultural Research Service have developed a new strain of rice with substantially more of the amino acid lysine than conventional rice strains have. Lysine is the essential amino acid that is in the shortest supply in rice and many other grains; thus, it limits the nutritional value of rice. The new rice produces about 10% more protein—and protein that contains 5 to 7% more lysine—than do other rice strains.

The work is being done by Gideon Schaeffer and associates in USDA's Cell Culture and Nitrogen Fixation Laboratory at Beltsville, Md. So far, they have grown the new strain through five generations in greenhouses and one season in field tests at Stuttgart, Ark. The next step will be to try to crossbreed this strain with others that are particularly well adapted to U.S. growing conditions. This will be done using conventional plant breeding techniques.

The high-lysine rice was developed by a technique known as anther culture, in which pollen grains (produced by the anthers of rice flowers) are cloned, and mutants with a desired trait are selected out chemically. These desirable mutants then are treated with plant hormones and grown into small plantlets in test tubes, transferred to pots of soil, and grown to maturity. Their seeds are used to produce the next generation of plants.

Pollen is used as the starting material because it is composed of haploid cells that have single, rather than paired, chromosomes. Thus, whatever genes are present in these cells will be expressed in the plant. This greatly reduces the amount of crossbreeding needed for desirable traits to be expressed and means new strains can be developed much faster and at lower cost.

High-lysine-producing clones are selected by growing the cells in a medium containing aminoethylcysteine, a substance that inhibits the enzyme aspartokinase, which directs the final step in the biosynthesis of lysine. Mutants that can grow in this medium somehow have managed to overcome this restriction and still make lysine. Exactly how they do this is not known, but they may have a second mechanism for making lysine that does not involve aspartokinase. Alternatively, they may produce a modified enzyme that is not sensitive to inhibition. Whatever their method, such mutants produce more lysine under normal growing conditions than do other rice plants. □

Schaeffer examines high-lysine rice

California academics face disclosure rules

Regulations proposed recently by the California Fair Political Practices Commission (FPPC) will bring research scientists at the University of California under much the same conflict-of-interest rules that govern other state officials.

Under the proposed regulations, any university scientist receiving research funds from a private firm must declare whether he or she has a financial interest in that firm and the magnitude of that interest. According to FPPC's chairman Tom K. Houston, a financial interest includes income or gifts from or stockholdings in a company. It also includes holding a management position in a company or serving on its board of directors.

"If a conflict of interest is revealed," Houston says, "the university will have to set up an independent panel to undertake a substantive review of the research project to decide if it can go forward and under what circumstances." Houston says that who will serve on such panels and how they will function is being left up to the university.

The regulations are scheduled to be adopted formally by the commission at a meeting on March 1. Houston says that he does not expect any substantive changes as a result of public comment.

Houston emphasizes that University of California scientists are not being singled out for special treatment. "All state employees who have decision-making authority currently are required to disclose all interests in businesses that they may affect by their decisions," he says. University scientists have been the only exception, Houston points out, because of concerns about academic freedom.

"That concern still holds," he says. However, according to Houston, several scientists testified at FPPC hear-

Mariella to retire as ACS executive director

Raymond P. Mariella has announced that he will retire as executive director of the American Chemical Society when his five-year term expires Dec. 31, 1982. Mariella has agreed to assist the chairman of the ACS Board in a consulting capacity in 1983 and 1984. Clayton Callis, currently board chairman, says that during Mariella's administration the financial condition of the society has been improved substantially and ACS membership has grown steadily to a record level of almost 123,000 members worldwide. In addition, a number of services to the membership have been strengthened and augmented. Mariella has been particularly active in recent months in promoting improved relationships with chemical and other professional societies around the world. He also has been instrumental in providing information about chemists and chemistry to government officials and their staffs in order to assist them in understanding the technical issues with which they are confronted.

ings that they were reluctant at present to share data and resources with certain other scientists whom they suspected of having ties to private industry and using the information for private gain. "They said that nondisclosure actually was inhibiting the flow of information," he says.

The FPPC action is the result of the increasingly tangled relationships between academics and the private sector, particularly in genetic engineering (C&EN, Oct. 12, 1981, page 39). According to a representative of the University of California, in December 1981 the university put out guidelines (which had been under development for more than a year) with essentially the same requirements as the FPPC rules. □

Chemicals to recover in 1982, government says

In a winter that has brought an increasingly sober view of 1982 in the U.S. chemical industry, the government is trying to sound a note of cheer. It says there will be recovery later this year and that chemicals will do better than average.

Bristling with statistics, the Commerce Department has issued its annual "U.S. Industrial Outlook" (available for $10 from the Government Printing Office). The 446-page tome will not reward connoisseurs of style and it cries for a summary. But in its deliberate way, the volume sides distinctly with the optimists about business prospects.

Commerce admits that the recession inherited from late 1981 will last through the first three months of 1982. But that's it, the government contends. After the winter, a slow recovery is in store with "some reduction" in the recent depressingly high inflation and interest rates.

Getting immediately to the numbers, Commerce pins down everything from gross national product to shipments of lawn and garden equipment to a decimal point. For the big statistic, the new volume puts the real-dollar increase in gross national product this year at 1.4%, down from 2.1% in 1981. That's pretty slow growth but at least is not another economic decline.

In chemicals, Commerce foresees faster real-dollar shipments growth than for either GNP or the nondurables family of manufacturing industries, in which chemicals rank just behind food as the second largest. For the broad category of chemicals and allied products, Commerce puts deflated shipments growth at 2.4% in 1982, up from 2.0% in 1981. Combined with the government estimate of 9.5% inflation in 1982, such growth would give chemicals a shot at $200 billion in sales, up roughly 12%.

In other sections, the Commerce outlook volume examines a host of smaller industry subcategories, ranking them for both current and long-term growth. Certain chemical and related groups make the higher growing lists for both 1982 and the long-term. But in general, Commerce says that these chemical groups will drop position in 1982 and have slowed greatly from the mid-1970s. □

Most chemical, related fields drop in growth ranking in '82

Shipments[a]	1980–81 % Change	1980–81 Rank	1981–82 % Change	1981–82 Rank	Industry code
Plastic products	11.0%	7	6.6%	28	3079
Biologicals	10.7	8	7.5	19	2831
Synthetic rubber	10.0	9	6.8	24	2822
Medicinals and botanicals	7.6	14	7.5	19	2833
Plastics	6.3	23	6.7	26	2821
Inorganic pigments	5.2	31	1.6	117	2816
Surfactants	3.8	39	3.8	58	2843
Photographic equipment	3.2	52	4.5	47	3861
Soaps and detergents	2.3	63	2.3	103	2841
Industrial organic chemicals	2.2	65	2.1	106	2819
Pharmaceuticals	1.8	74	1.8	113	2834
Pesticides	1.3	83	1.2	128	2879
Paint	1.0	89	1.9	112	2851
Industrial organic chemicals	0.8	95	0.4	143	2860
Nitrogenous fertilizer	0.8	95	0.8	137	2873
Cosmetics	0.6	99	1.4	123	2844
Phosphate fertilizer	0.0	108	2.7	91	2874
Chlorine-caustic	−1.1	117	−1.3	152	2812
Industrial gases	−2.9	128	1.3	126	2813

a Rankings are for industry subgroups in 168 categories. Source: Commerce Department

White House science advisory panel approved

The men around President Reagan finally have gotten around to approving members of the White House Science & Technology Council nominated by science adviser George A. Keyworth late last year. It is a 13-man group, chaired by Solomon J. Buchsbaum, vice president of Bell Telephone Laboratories. Vice chairman of the group is Edward Frieman, vice president of Science Applications Inc. of La Jolla, Calif. Unlike the former President's Science Advisory Committee, the group will counsel Keyworth, not the President.

On the face of things, the science and technology council seems heavily oriented toward national defense. Members include Harold M. Agnew, formerly director of Los Alamos National Laboratory and now president of General Atomic Co.; George A. Cowan, a Los Alamos physicist; Edward E. David, president of Exxon Research & Engineering who made his name in naval acoustics; David Packard, chairman of Hewlett-Packard Co.; and Edward Teller, founder of Livermore National Laboratory, so-called father of the hydrogen bomb, and now a senior research fellow at Stanford University's Hoover Institution.

Rounding out the council are John Bardeen, emeritus professor of electrical engineering and physics, University of Illinois; D. Allan Bromley, professor of physics at Yale; Paul E. Gray, president of Massachusetts Institute of Technology; Robert O. Hunter Jr., president of Western Research Co.; Arthur K. Kerman, director of the center for theoretical physics at MIT; and Donald S. Frederickson, a physician, formerly director of the National Institutes of Health and now a fellow at the National Academy of Sciences. Frederickson is the only life scientist on the panel. No chemist, biologist, or social scientist was appointed.

The council will meet for the first time next month. Keyworth is deciding whether to open the meetings to the public and the first agenda is being drawn up. □

Outlook dims for decontrol of natural gas

Fear of future supply shortages and inequities under the Natural Gas Policy Act, however, keep chemical industry fighting for total price decontrol

Earl V. Anderson
C&EN, New York

A lot of people in the chemical industry are watching the nation's capital to see if, by some miracle, they will get some action on decontrol of natural gas prices.

They have been doing that for quite a while. And there was a time when it appeared as if they would get their wish—to get out from under the shackles of the Natural Gas Policy Act of 1978 (NGPA) and switch to total, phased decontrol of natural gas prices.

True, it would cost chemical companies more for their gas. But they are more concerned about an adequate and secure long-term supply of gas at "competitive" prices. They don't see that under NGPA.

Prospects for natural gas decontrol rose last year after President Reagan decontrolled crude oil prices. After all, deregulation was the name of the new Administration's game, and natural gas stood out as a major decontrol target.

But natural gas decontrol is a much tougher nut to crack than oil. President Reagan was able to use an executive order to decontrol oil prices. Natural gas decontrol will require Congressional action.

Still, prospects looked good until recently. Several bills introduced last year were designed to remove wellhead price controls of natural gas. The most promising was legislation introduced by Rep. Phil Gramm (D.-Tex.), which decontrol advocates felt comfortable with. Several times last year, the Administration seemed on the verge of sending up to the Hill its own bill to phase out natural gas price decontrols. It never happened.

Even this year, prospects looked good for natural gas decontrol. Word around Washington was that President Reagan was again ready to submit his own decontrol proposal to Congress. Rep. Gramm reintroduced his own bill and, on the Senate side, Sen. J. Bennett Johnston (D.-La.) introduced a bill similar to the Gramm bill. With legislative proposals in both houses, and an Administration receptive to deregulation, things were beginning to look up.

Pipeline network at Houston Pipe Line's Bammel Field storage reservoir, Houston

But that fickle barometer Washington watchers use to gauge legislative prospects such as natural gas decontrol has dropped from optimistic to pessimistic. Chances of passing a gas decontrol bill this year now appear slim. "It's becoming discouraging," says Patrick H. McNamara, Dow Chemical's government relations manager and cochairman

Natural gas and natural gas liquids are lifeblood of the chemical industry

	1980 consumption, trillion Btu			
	Petrochemicals	%	Total chemicals & allied products	%
Fuels	**2276**	**100.0%**	**3636**	**100.0%**
Natural gas	1276	56.1	1506	41.4
Distillate & resid	203	8.9	298	8.2
Coal	156	6.8	266	7.3
Purchased electricity	641	28.2	1566	43.1
Feedstocks	**2540**	**100.0**	**2540**	**100.0**
Natural gas	588	23.2	588	23.2
Ethane	456	17.9	456	17.9
Propane	442	17.4	442	17.4
Butane	147	5.8	147	5.8
Isobutane	20	0.8	20	0.8
Heavy liquids	887	34.9	887	34.9

Source: Arthur D. Little Inc.

of the Petrochemical Energy Group (PEG).

Apparently, natural gas decontrol has run out of time. Those with political savvy say that if no action is taken by the end of this month, natural gas decontrol is dead, at least for this year. Congress will be overloaded with many issues that are considered more important, not the least of which are the budget and the economy.

With many Congressmen up for re-election later this year, they are looking forward anxiously to early adjournment. And many of them don't relish the idea of facing the voters with talk of supporting a bill that could raise their already rising gas bills.

Opposition groups, such as the American Gas Association and several consumer-citizen groups, are fanning that issue. A cornerstone argument is that decontrolling natural gas prices will serve only to fuel inflation. Says Rep. Dan Glickman (D.-Kan.), "to [decontrol gas] would be a slap in the face to the people... we are working to protect from inflation."

Time, the economy, and the upcoming elections seem to be working against natural gas decontrol this year. And faced with a full, short calendar, legislators don't relish the prospect of dealing with a complicated issue that is complicated further by the possibility of a windfall profits tax.

The smart money says that Congress won't pass a decontrol measure without a windfall profits tax. Yet, President Reagan is already on the record—written record—that he will veto "with pleasure" any bill that contained a windfall profits tax.

Contrary to what "the smart money" says, many decontrol advocates don't believe that a windfall profits tax is inevitable. Lobbyists have been doing a lot of "educating" on Capitol Hill, and many Congressmen who felt that a windfall profits tax wouldn't cost the public a cent now understand that it is really a tax on the consumer—hidden, no doubt, but there nonetheless.

A tax on natural gas probably would be an excise tax rather than an income tax. Such a tax would tend to crimp production. The result, for consumers, would be less gas, but they would pay more for it.

Faced with a staggering federal deficit, a windfall profits tax also looks appealing because it could pour much-needed dollars into the Treasury. But according to Chase Econometrics, a natural gas excise tax that would generate $15 billion in 1985 tax revenues would bring a net improvement of only $1 billion because of various offsets.

Natural gas prices will vary widely among pipeline firms

Pipeline company	Prices in $ 1981 per million Btu[a] 1985	1990
Algonquin Gas Transmission	$5.22	$6.54
Cities Service	3.05	5.31
Colorado Interstate	3.36	5.61
Columbia Gas Transmission	4.93	7.26
Consolidated Gas Supply	5.05	7.66
El Paso Natural Gas	3.40	5.21
Florida Gas Transmission	4.13	7.02
Michigan Wisconsin	4.56	6.85
Midwestern Gas Transmission	5.57	7.70
Mississippi River Transmission	5.59	7.46
Natural Gas Pipeline	4.26	6.33
Northern Natural Gas	4.15	6.44
Northwest Pipeline Corp.	4.50	5.41
Pacific Gas Transmission	5.75	7.41
Panhandle Eastern	4.00	5.98
Southern Natural Gas	4.92	7.17
Tennessee Gas Pipeline	4.21	6.52
Texas Eastern Transmission	4.06	7.73
Texas Gas Transmission	4.80	7.55
Transcontinental	4.00	6.05
Transwestern	4.98	6.46
Trunkline Gas	4.47	6.10
United Gas	5.36	7.35

[a] Average cost to pipeline companies, depending upon mix of regulated, deregulated, and substitute gas supplies. Source: Foster Associates

Meanwhile, as gas output and consumption went down because of the tax, economic growth also would go down. Chase estimates that the $15 billion excise tax would reduce 1985 gross national product by $30 billion. That's a lot to pay for a $1 billion reduction in the deficit.

Obviously, the political battle over natural gas decontrol won't be easy, especially with the dispute over a windfall profits tax complicating the issue.

It already may be too late to do battle, at least this year. If so, natural gas will continue under NGPA, with partial decontrol coming in January 1985. Now there are even indications that an extension of phased-decontrol all the way to 1988 will be pushed.

To the chemical industry, that would be unthinkable. Basically, what the chemical industry wants is phased decontrol of all natural gas prices by a single date, preferably by 1985. Different categories of gas under NGPA should not have different target dates, the industry argues.

But unless decontrol legislation is enacted this year, achieving total decontrol by 1985 will be difficult. There just wouldn't be enough time to phase it in.

Despite the obstacles, the industry isn't giving up the fight. To chemical companies, an adequate and reliable supply of natural gas at a competitive price is paramount. They know that decontrolling natural gas prices is going to increase their feedstock and fuel costs, but these costs are going up anyway, even under NGPA, and the primary concern is supply.

In this, the industry is virtually united. PEG and the Chemical Manufacturers Association (CMA) are handling the political effort in Washington. All but a very few companies whose particular oxen aren't being gored by NGPA are solidly behind this effort.

Little wonder. Natural gas is the lifeblood of the industry. The chemical industry accounts for more than 10% of total U.S. natural gas consumption—about 3% for feedstock and 7% for process fuel and other uses. For feedstock, it also consumes large amounts of natural gas liquids (NGLs) extracted from gas streams. NGLs are certain to be affected by what happens—or doesn't happen—to natural gas decontrol.

To PEG, CMA, and its chemical company members, the villain is NGPA. They feel that the wellhead price controls established under NGPA are causing serious problems not only for the industry, but for the entire nation. These problems likely will get worse.

NGPA was supposed to decontrol natural gas prices without disrupting the market. So far, it hasn't come close to succeeding. The market already is disrupted. There are 26 categories of natural gas spelled out in NGPA. Prices vary widely from pipeline to pipeline, often within the same geographical region. Some pipelines have gas running out of their ears. Others are short.

As Jan. 1, 1985, approaches and substantial amounts of gas become decontrolled under NGPA, the disruption could become more severe.

NGPA opponents are adept at compiling long lists of complaints about the law. They don't like its

Natural gas liquids will be affected by decontrol

1985 demand, thousands of barrels per day	1980	Gas decontrol options: Current decontrol act	Controls phased out by 1988	Complete decontrol by 1985
Ethane				
Chemicals	376	249	405	407
Total	465	284	528	460
Gas plant production	408	279	455	455
Propane				
Chemicals	244	262	313	313
Total	802	851	954	934
Gas plant production	483	321	433	433
Butanes				
Chemicals	87	118	117	117
Total	398	402	413	413
Gas plant production	313	259	263	263

Source: Resource Planning Consultants

phased decontrol structure. They don't like its incremental pricing provisions. But the act's biggest shortcoming is that some of its basic premises have been proved wrong.

The most serious, perhaps, is that the bill's designers, with an eye toward parity between oil and gas prices by 1985, estimated that crude oil would be selling for about $15 per barrel (in 1978 dollars) on the world market in 1985. They didn't foresee the second oil crisis of 1979–80. As a result of that crisis and the runup in prices, refiner acquisition costs for crude oil last year averaged about $37 per bbl, or about $29 in 1978 dollars.

Although NGPA provides for some decontrol, it is as much a control bill as it is a decontrol bill. It slaps price controls on most natural gas and stipulates monthly inflation and escalation adjustments. It controls access to some natural gas, such as offshore gas, and even controls the terms under which some gas is purchased.

Under the old Natural Gas Act, interstate natural gas price was regulated. Intrastate gas price wasn't. But NGPA extends price controls to intrastate gas now and gives interstate pipelines access to intrastate gas reserves. Taken separately, each of these controls creates problems for producers, pipelines, and consumers alike. Taken together, these problems become even more difficult and complex.

Problems related to price controls are probably the most serious of the lot, at least as far as the chemical industry is concerned. So far, only one small category of natural gas has been deregulated by NGPA. That's the so-called "107" gas (after the section number in NGPA that controls it.). Known universally as "high-cost gas," most of it flows from deep wells (15,000 feet or deeper). Section 107 gas now accounts for only 4% of natural gas production, but some pipelines are paying as much as $9.00 to $11 per thousand cu ft to get it. In the process, a few producers are getting very rich. Not surprisingly, these producers like NGPA just as it is.

On Jan. 1, 1985, NGPA decontrols the prices of some additional categories of gas. The largest slug will be "new" gas (section 102). This gas now represents about 20% of natural gas output, but it will swell to about 42 to 45% by 1990. Some of the other gas that will be decontrolled in 1985 is old intrastate gas (section 105). Old interstate gas (section 104), however, remains under control.

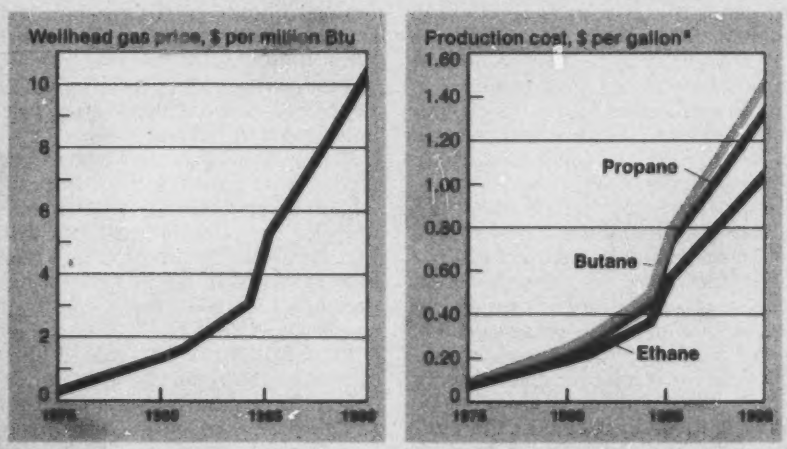
As far as the chemical industry is concerned, the key word in all of this is "some." Contrary to what many believe, not all gas prices come out from under controls in 1985. A lot—a whole lot—of gas will remain regulated permanently after 1985. And even some that is deregulated can be shoved back under price controls until 1986 by Presidential action.

Even the experts can't agree on just how much gas will remain under price controls after 1985. The guessing falls between 40 and 60%. Whatever the figure, it is substantial. And it is this aspect of NGPA—that only some controls on some gas will disappear in 1985—that troubles the chemical industry most. For gas-dependent chemical companies, the problem is not the gas that comes out from under price controls, it is the gas that remains controlled.

This one-shoe-off, one-shoe-on approach is creating a problem that everyone refers to as the "cushion" problem. The cushion problem has altered the competitive positions of interstate and intrastate pipeline companies. Where once the intrastate companies were in the driver's seat, it is now the interstate pipelines that have the upper hand.

Here's how the cushion works. Company A has a large supply of low-priced gas that is controlled by NGPA (its cushion). Company B has very little of that gas. As a result Company A can bid much more for its new supplies of decontrolled gas, such as 107 deep gas, than can Company B. It can do this because it can average, or "roll in," the high price

As natural gas prices rise... ...gas liquid costs also go up



a Costs include fuel, shrinkage, tax, extraction premium, operating costs, and capital charges.
Source: McClanahan Consultants

A lot of natural gas will remain regulated permanently after 1985

Section	Description	Decontrolled
102	New natural gas	
	Certain new onshore wells	Jan. 1, 1985
	New onshore reservoirs	Jan. 1, 1985
	New offshore leases	Jan. 1, 1985
	New reservoirs on old offshore leases	No
103	New onshore production wells	
	Deeper than 5000 ft	Jan. 1, 1985
	Shallower than 5000 ft	Jan. 1, 1987
104	Old interstate gas	
	Post-1974	No
	1973–74	No
	Replacement contract or recompletion gas	No
	Flowing gas	No
	Certain Permian Basin gas	No
	Certain Rocky Mountain gas	No
	Certain Appalachian gas	No
	Minimum-rate gas	No

Section	Description	Decontrolled
105	Old intrastate gas	
	Contract price less than $2.078 on Nov. 9, 1978	Jan. 1, 1985
	Contract price more than $2.078 on Nov. 9, 1978	Jan. 1, 1985
106	Gas sold under "rollover" contracts	
	Interstate	No
	Intrastate	Jan. 1, 1985
107	High-cost gas	
	Wells 1500 ft or deeper	Nov. 1, 1979
	Geopressured brine, coal seams, and Devonian shale	Nov. 1, 1979
	Tight sands	No
	Qualified production enhancement	No
108	Stripper wells	No
109	Other categories (including Prudhoe Bay)	No

it paid for the new gas with the much lower price it paid for the old gas and still sell to its customers at or below the cost of alternative fuels. NGPA's basic premise about the 1985 target price of oil made sure of that.

Company A also can outmarket other companies who are not fortunate enough to have the cushion. Companies that enjoy cushions can bid up the price of decontrolled, 107 gas above what the industry calls market-clearing levels and still compete effectively in the market.

For most chemical companies, the important question is who has the cushion? Unfortunately for them, the answer is the interstate pipeline companies.

Remember that much of the petrochemical industry is located on the Gulf Coast, in Texas and Louisiana. That is intrastate market territory. Many plants in the area already are starting to feel the squeeze caused by the cushion problem.

Interstate pipelines will have a large volume of old (section 104) gas remaining under price controls until their reservoirs are depleted. They can afford to pay the much higher prices for decontrolled, 107 gas. That's exactly what they are doing now.

Intrastate pipelines, meanwhile, will be forced to meet those wellhead prices for new gas if they want to replenish their supplies. But intrastate lines don't have that big cushion of 104 gas. Its old (105) gas becomes decontrolled in 1985.

What this means is that intrastate pipelines will be paying, on average, more for their purchased gas than their interstate counterparts. According to the Energy Information Administration (EIA), old intrastate gas will be going for $3.29 per thousand cu ft at the wellhead in 1985. Old interstate gas will be a substantially lower $1.01. That's a hefty cushion in the bidding for new gas.

It's also bad news for chemical companies that must rely on intrastate pipelines for their gas supply. Although all companies on intrastate lines will be hurt, those that use natural gas as a feedstock, such as ammonia and methanol producers, will feel the impact even more.

Monsanto, for instance, is facing a serious problem at its Luling, La., ammonia plant precisely because of the 104 cushion situation. Its present gas contract expires at the end of 1983. After that, if it is able to buy any gas at all, it will be only at uncontrolled prices. That could mean a price increase of $2.00 to $3.00 per thousand cu ft, which translates into an $80 to $120 per ton difference in the cost of ammonia.

For Monsanto, that's a tough pill to swallow when ammonia is expected to be selling for about $420 per ton in 1985. And it's too much of an edge to give to ammonia producers that are not on an intrastate pipeline.

To Charles P. Fullerton, Monsanto's director of planning and energy policy, the solution is simple. Remove controls on 104 gas at the same time that controls are lifted on other gas categories.

Other ammonia producers tied in to intrastate pipelines no doubt agree. They account for 60% of U.S. ammonia output. The 40% on interstate lines may or may not agree, depending upon where they are located. That is because not only is there a wide disparity between interstate and intrastate prices, but there are wide-ranging differences even among interstate lines. In a study that it made for PEG, Foster Associates estimates that in 1985 the average, rolled-in price of gas could vary as much as 90% among interstate pipelines. This means that even in the same region, one chemical company could be paying much more for its gas than another. It depends upon who the supplier is.

As concerned as petrochemical companies are about natural gas, they are just as concerned about natural gas liquids. NGLs are a big part of the industry's feedstock picture. What happens to natural gas—its degree of regulation, its supply, and its price—will influence the price and supply of NGLs.

Natural gas processors who extract NGLs from gas streams are as uncertain about their future as the natural gas industry is about its own. For them, the big questions are what happens to NGL as the price of natural gas increases, and should the processor extract NGL from the gas or leave it in for its Btu value? These questions are important ones for the petrochemical industry, too.

The processor is between a rock and a hard place. It sees its costs rising and knows it must raise its NGL prices to make a profit. But it

also knows that NGL is highly price-competitive and that there is a limit to what the market will bear.

NGL's track record over the past few years bears this out. During 1979 and 1980, ethylene producers that had the flexibility to use either light feedstock (NGL) or heavy feedstocks such as naphtha or gas oil found little to choose from between the two. On a per-pound of ethylene basis, both were competitive.

Last year, NGL prices started dropping and light feedstocks captured a competitive edge. The market responded. The share of ethylene output from ethane and propane went up 4% last year. About half of the heavy liquids crackers in the country are using ethane or propane.

That's fine for those liquid-based olefin plants that have the flexibility to switch to light feeds when the price is right. And recently the price has been very right. Ethane has been selling for 20 cents per gal and less.

But don't expect to see any new ethane-only cracking units soon just because today's price is right. That price probably won't last long. Upward pressures already are becoming apparent.

More important, says Dave McClanahan of the consulting firm McClanahan Associates, it has become increasingly difficult to get ethane in large enough volumes to justify new ethane crackers. Small, economic cryogenic extraction plants now make it possible to extract ethane even from small gas packages. But ethane pipelines, says McClanahan, though extensive, are not universal. As a result, not all of the little extraction plants capable of recovering ethane are or will actually do it.

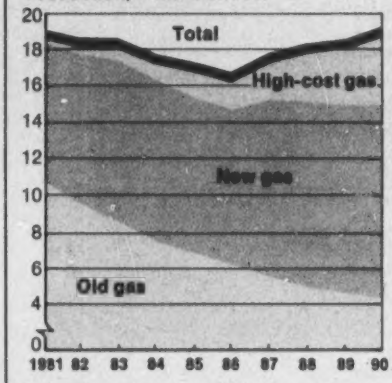
The problem as he sees it is one of limited ethane demand. There has been very little ethane- or ethane/propane-based ethylene capacity installed in the past few years. The buildup in ethane-based capacity has come from revamping heavy liquids units.

Not until after the mid-1980s does he see more ethane or propane crackers being built in the U.S. Until then, because operating rates are low, there won't be much locked-in demand at plants that can use no other feedstock.

This, McClanahan says, means that ethane prices will be in competition with propane and subject to downward pressures because of a weak crude oil market during the early 1980s.

Carlton R. Jones, president of Resource Planning Consultants, agrees that NGL prices will be influenced by crude prices. But he also thinks that NGL prices will remain at levels that will enable them to maintain their competitive position in major feedstock and fuel markets.

Natural gas mix will change dramatically



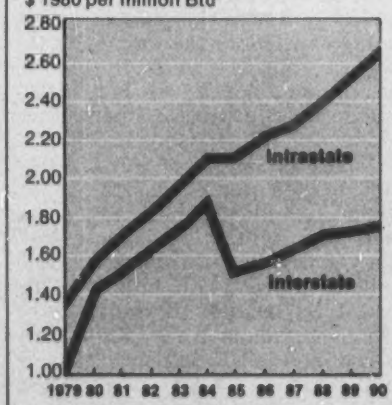
Note: Old gas, new gas, and high-cost gas as defined in Natural Gas Policy Act. Source: Energy Information Administration

To get an idea how natural gas decontrol will affect NGLs, Resource Planning constructed three possible scenarios for decontrol:

- NGPA as is—the provisions of NGPA continue in effect.
- Full decontrol in 1985—all price controls are eliminated on Jan. 1, 1985.
- Phase-out of controls by 1988—phased deregulation of all gas supplies over a 36-month period.

Jones says that given Congress's propensity for delaying hard decisions, the 1988 phase-out is the most likely scenario.

Intrastate gas will be more expensive than interstate



Source: Energy Information Administration

For the gas processor, the route to decontrol is important. The volumes of gas it has to work with and the pricing of recovered NGLs depend on how or if gas is decontrolled.

Extending controls to 1988, Jones says, means that the high prices for already-decontrolled gas (107) will continue. But the volumes are small enough that this extension would have little impact on a gas processor.

Under NGPA's partial decontrol scheme, large volumes of gas will be deregulated and gas prices will be relatively high. This would put the squeeze on processor profit margins, and processors will think about leaving the NGL in the gas stream.

However, according to Jones, complete decontrol by 1985 would lower the decontrolled price of gas to about the average gas cost. Under these conditions, NGL extraction would remain profitable.

Whatever happens, ethane will be the NGL that will be affected most by decontrol. For the petrochemical industry, that's significant, because more than 85% of all ethane goes into olefins plants as a feedstock. Use of ethane as an olefins feedstock has increased nearly 70,000 bbl per day over the past three years. Much of this growth has come from steam crackers designed for heavy liquids. Jones estimates that by 1985, these heavy liquids crackers will have the capacity to crack 158,000 bbl per day of ethane.

But, unlike light feedstock crackers that have limited flexibility, these converted plants will crack ethane only if it is more economical than naphtha or gas oil. Jones estimates that, in 1985, a gas oil cracker will value ethane at 35 cents per gal (in 1981 dollars).

If NGPA remains in force, shrinkage and the fuel cost of ethane from decontrolled interstate gas would amount to 42 cents per gal. Unable to tolerate such losses, processors would leave ethane in the gas. As a result, Jones estimates that 1985 ethane production would be about 176,000 bbl per day less than potential supply.

However, if gas were decontrolled fully by 1985 or even phased in gradually through 1988, almost all of the potential ethane could continue to be processed. And it could be priced attractively enough for a heavy liquids cracker.

Both phased or full gas decontrol probably would assure ethane's continued growth as an olefins feedstock.

U.S. will be squeezed out of basic petrochemical trade

Per cent share of world trade	Exporters 1979	1985	1990	Importers	1979	1985	1990
ETHYLENE DICHLORIDE							
U.S.	90%	29%	10%	Japan	73%	35%	58%
Western Europe	9	20	10	Asia-Pacific[a]	26	66	6
Canada	1	28	44	Communist countries	—	28	36
Middle East	—	23	28	Latin America	1	—	—
Latin America	—	—	8				
STYRENE							
U.S.	78	16	—	Western Europe	29	37	28
Canada	22	80	71	Latin America	25	12	10
Communist countries	—	4	2	Asia-Pacific[a]	20	26	22
Middle East	—	—	27	Communist countries	11	—	—
				Japan	9	20	19
				Middle East	6	5	7
				U.S.	—	—	14
LOW-DENSITY POLYETHYLENE							
Western Europe	45	38	13	Asia-Pacific[a]	42	55	48
U.S.	31	11	7	Latin America	24	17	17
Canada	5	28	37	Africa	23	26	24
Japan	19	9	—	Communist countries	7	2	14
Middle East	—	14	43	Middle East	4	—	—
HIGH-DENSITY POLYETHYLENE							
Western Europe	48	24	12	Asia-Pacific[a]	46	33	36
U.S.	36	34	11	Latin America	23	36	44
Japan	15	16	8	Africa	20	26	20
Canada	1	18	52	Communist countries	6	—	—
Communist countries	—	8	5	Middle East	5	5	—
Middle East	—	—	12				

a Excludes Japan. Source: Exxon Chemical

But if NGPA remains in force, look for a big shift back to heavy liquids.

Unlike ethane, most propane does not go into petrochemical feedstock. It goes into the fuels market where conservation and availability of alternate fuels will restrain demand regardless of the decontrol scenario.

But it probably would be the feedstock market that would feel the greatest impact from variations in decontrol scenarios. Jones expects 1985 propane prices to be about 9 cents per gal (1981 dollars) lower under full or phased decontrol than they would be if NGPA remains untouched. Like ethane, propane would lose its economic advantage under NGPA, and about 50,000 bbl-per-day less propane would flow into chemical plants.

Butane is a different story. How natural gas is decontrolled, or even whether it's controlled at all, will have little impact on butane market demand or pricing. It makes little difference to the gas processor. And, even in 1985, butane prices will continue to be dictated by refining values, even though its value as a petrochemical feedstock will play an increasingly important role.

Because natural gas and natural gas liquids are so vital to the chemical industry, it's easy to see why it is so concerned about what the Administration and Congress do about natural gas decontrol. A lot is at stake.

Not only will the outcome of decontrol influence the way the industry does business in its own domestic market, but it will help determine its performance in international trade, say industry spokesmen.

There's a degree of truth in that, but only a degree. Certainly the chemical industry has been a star performer on the U.S. export stage. Last year's chemical exports of $21.2 billion added $11.6 billion to the country's balance of trade. Petrochemicals alone contributed about $13 billion to $15 billion to that export total.

There's good reason, then, for the chemical industry to argue against a U.S. policy that encourages continued oil imports, natural gas imports from Canada and Mexico, and even expensive liquefied natural gas imports from Algeria while it maintains NGPA price controls that limit U.S. gas production.

But when push comes to shove, what happens to natural gas decontrol may have no bearing whatever on future prospects for U.S. petrochemical exports, especially the basic, commodity products such as high- and low-density polyethylene, ethylene dichloride, and styrene.

With or without decontrol, plenty of less expensive gas will be available somewhere else in the world to feed competing petrochemical industries. Saudi Arabia and other Middle East countries are a prime example. So, too, are Mexico and Canada. Additional low-priced competition will be emerging from communist countries in Europe, perhaps even from China.

How much basic petrochemicals these countries export will depend on how much they produce, domestic demand, when their plants come on stream, and how well these plants are operated. But in many countries, world-scale plants are going up that far exceed domestic requirements.

It's inevitable that these plants will aim for the export market. And they will do it with such force that the U.S. —and Europe and Japan— will not be able to hold them back.

A recent study by Exxon Chemical shows what might happen to U.S. commodity petrochemical exports. U.S. exports of ethylene dichloride (EDC), for instance, accounted for 90% of world EDC exports in 1979. By 1985, Exxon expects that share to drop to 29%, and by 1990 to only 10%.

Similar trends are apparent in low- and high-density polyethylene. Styrene is even worse. In 1990, the U.S. will be exporting no monomer at all, according to the Exxon study. In 1979, U.S. exports accounted for 78% of the world total. Last year, U.S. exports of ethylene derivatives were the equivalent of 8 to 10% of U.S. consumption. By 1990, that share will drop to 2%.

The year 1990 is still a long way off. Exxon's numbers may be off a bit. But the trend is inevitable and no possible scenario for natural gas decontrol will change it.

This in no way diminishes the importance of the gas decontrol issue for the chemical industry. It still sees NGPA as the villain as far as future gas supplies are concerned. □

Engineering plastics battle recession

Demand for these plastics was down overall in 1981 but is still growing for some products and likely will pick up in second-half 1982

Patricia L. Layman
C&EN, New York

Talk with any number of people in the engineering plastics business, and you can get about that many definitions of the term itself. But slowly, some key features start emerging, painting the polymers as high-performance materials able to withstand serious stress under hostile environments such as high temperatures for prolonged periods of time and allowing competition for markets with such materials as metals and glass. They are the most profitable and, historically, the fastest-growing segment of the plastics industry.

Even now, when the overall plastics industry is in dreary shape, engineering plastics are doing better. That's not to say they haven't been hurt by the economic downturn. Says one market researcher, "1981 was down—no question about it." But "down" for engineering plastics producers, in 1981 and probably through the first half of 1982, basically means demand and output that are level or only slightly down; some resins actually maintained a small—less than 4%—growth.

However, indications are that things will pick up in the second half of the year. And when that happens, marketers agree, engineering plastics will be well on their way back to the 12 to 15% annual growth rate they have been accustomed to, a growth rate expected to continue through the 1980s.

It's to capture some of that fast-growing business that the industry has been expanding and is continuing to put money into more expansions. In January, for example, General Electric announced a 10-year, $1.5 billion plan for expanding its engineering plastics program. And earlier this month it introduced what it calls a completely new family of polyme[illegible]lyetherimides, that will be m[illegible] under the tradename Ultem (C&EN, Feb. 15, page 6).

Phillips Petroleum completed a 3 million lb-per-year expansion of its polyphenylene sulfide plant at the end of last year, bringing total capacity to 9 million lb. It is adding another 500,000 lb of capacity this year, with yet another increase—to a total of 12 million lb per year—slated for 1983.

Mobay last year completed a new plant for making polycarbonates at Baytown, Tex., adding to its capacity. And Dow Chemical, which now has a pilot plant producing polycarbonate resins, plans to be in full-scale production by 1984.

Du Pont is constructing a new plant for its Zytel nylon in Japan, due for completion in 1983. Allied Corp. is expanding its capacity for fluoropolymers at Orange, Tex., with the expansion slated for completion this spring.

And at least two other producers of engineering plastics—GAF and Union Carbide—are contemplating new plants. Carbide is considering a plant for polyarylide resin, which it now imports from Japan, and GAF says that expansion of its polybutylene terephthalate polyesters "is in the cards."

All this effort is being aimed at a market that requires suppliers to have one important attribute: patience. Because marketers of engineering plastics are selling not so much product as performance, it takes time for customers to evaluate a product or work it into potential production and design schemes. Manufacturers are faced with the time required for testing to meet regulatory or insurance requirements—for meeting Underwriters' Laboratories requirements, for example, or Food & Drug Administration standards.

In fact, most marketers agree that it takes a minimum of two years to get from initial sampling of an engineering plastic to commercial sales. That kind of time and the often hefty amounts of up-front money frequently are difficult for hard-pressed managements to accept, marketers say. However, its acceptance is crucial to success in the business. As one marketer puts it, "It takes a lot of patience and a lot of staying power."

It takes a commitment, for example, to jump completely into the market and stay there as a serious

Nylon, polycarbonate lead engineering plastics

Millions of lb	1981 consumption
Nylon	275
Polycarbonate	250
Modified polyphenylene oxide	125
Acetal	95
Thermoplastic polyesters	55
Polysulfone	10
Polyphenylene sulfide	7
Others	1
TOTAL	818

Sources: Celanese, industry estimates

1981 U.S. use of engineering plastics is still below 1978

Millions of lb	1981	1980	1979	1978	1977
Electrical/electronic	255	240	293	231	202
Transportation	155	159	197	187	173
Building and construction	75	75	106	81	72
Industrial/machinery	75	75	93	98	86
Consumer/institutional	50	49	53	54	51
Packaging	30	28	38	27	23
Other	90	91	71	71	64
TOTAL	730	727	852	747	670

Note: Excludes exports. Includes engineering plastics: nylon, acetal, polycarbonate, polyphenylene sulfide, thermoplastic polyester, polysulfone, and modified polyphenylene oxide. Includes specialty plastics: polyimides, polyamide-imides, and fluoropolymers. Sources: Society of the Plastics Industry, industry and C&EN estimates

Eighteen firms have 1.5 billion lb of capacity for 11 plastics

	Plastic (capacity, millions of lb)
Adell Plastics	Nylon (20)
Allied Corp.	Thermoplastic polyester (5)
	Fluoropolymers (3)
American Hoechst	Nylon (20)
Amoco Chemical	Polyimide (3)
	Polyamide imide (3)
Badische Corp.	Nylon (11)
Bemis	Nylon (20)
Celanese	Acetal (125)
	Thermoplastic polyester (70)
	Nylon (40)
Du Pont	Acetal (80)
	Thermoplastic polyester (25)
	Nylon (160)
	Polyimide (3)
	Fluoropolymers (20)
Firestone Plastics	Nylon (12)
GAF	Thermoplastic polyester (12)
General Electric	Polycarbonate (265)
	Thermoplastic polyester (130)
	Polyphenylene oxide (200)
	Polyether imide (10)
Goodyear	Thermoplastic polyester (10)
ICI Americas	Fluoropolymers (5)
Mobay	Polycarbonate (90)
	Thermoplastic polyester (20)
Monsanto	Nylon (70)
Phillips Petroleum	Polyphenylene sulfide (9)
Rilsan Corp.	Nylon (18)
Union Carbide	Polysulfone (15)

Sources: Society of the Plastics Industry, Industry and C&EN estimates

competitor. GE, which claims a one-third share of the worldwide $2.9 billion-per-year market for engineering plastics, provides a case in point. As one of the first projects under its $1.5 billion spending plan for the next 10 years, it has begun a new engineering plastics center at Montgomery, Ala.

Construction is scheduled to begin in early 1983 for the first module, which will be for Lexan polycarbonate. It will include production facilities for raw materials bisphenol A, chlorine, and caustic soda, polymerization facilities for polycarbonate resin, and a finishing plant for blending and coloring. Initial output is scheduled for late 1984 or early 1985, with production topping 100 million lb per year of Lexan. According to the company, each of the individual plants will incorporate new technology that the firm has developed over the past few years. Other modules envisioned by GE for the Montgomery site will produce other, unspecified engineering resins, and, by the late 1980s, basic silicone manufacturing.

The engineering plastics business also takes a willingness to customize a product, tailoring a resin for a specific customer or application. Du Pont, for example, points out that it sells 250 different kinds of nylon. A market of 1 million lb per year would be considered "gigantic" for engineering plastics, says another market manager; 10,000 lb per year is considered quite respectable. "In this business, you have to be prepared to consider everything," he says, adding, "The key to success is deciding what to pursue, and how far."

One factor making low-volume markets bearable, of course, is the ability of producers to charge for their custom development work and technical service. Prices of basic engineering plastics—generally acetals, polycarbonates, modified polyphenylene oxide, nylon, thermoplastic polyesters, polysulfone, and polyphenylene sulfide—run from a little more than $1.00 per lb to about $4.00. GE's new polyetherimides will sell for $4.25 to $6.50 per lb for the base resin. And prices of the more exotic materials, including polyimides, polyamide- and polyesterimides, and fluoropolymers, can start at $10 per lb and head upwards.

But even prices this high can prove acceptable to customers seeking to cut the weight of their products—one reason, for example, that engineering plastics are finding applications in the auto industry—or to customers seeking to simplify a production process by molding in one part, with colored resin, what otherwise might have been six separate components bonded or otherwise joined together and then painted.

Engineering plastics suppliers can provide resins to meet a host of needs: by filling resins with glass fiber, for example, or other compounds; by developing copolymer systems; or, increasingly, by developing what are basically alloy systems. Alloys always have been important to engineering plastics. GE's Noryl, for example, is a polyphenylene oxide modified with styrene. And Uniroyal was able to enter the engineering plastics business with its Rovel alloy, a styrene-acrylonitrile matrix saturated with a proprietary olefinic elastomer, probably a copolymer of acrylonitrile, EPDM (ethylene-propylene-diene-monomer), and styrene, rather than acrylonitrile-butadiene-styrene (ABS), which can have ultraviolet stability problems.

However, alloys are becoming increasingly important to the industry as suppliers attempt to cut already steep development costs. Among the more promising developments are the so-called elastopolymers—blends of polybutylene terephthalate with elastomers, for example, to replace rubber parts that have to be vulcanized.

At a plastics conference last year, for example, Bennett Nathanson, manager of commercial research and new business development at Celanese Plastics & Specialties Co., targeted several such alloys as potential stars. Elastomers are being teamed up with a number of resins. Du Pont and Allied alloy them with nylon for example, and GE alloys elastomers with polybutylene and polyphenylene oxide. Styrenics are the other major alloying materials—ABS with polysulfone, in one Union Carbide product, for example; ABS with polycarbonate from Mobay and Borg Warner; and acrylic styrene with polybutylene terephthalate from Toray.

Copolymers and alloys also are seen as a latchkey to the engineering plastics market for producers of such conventional resins as ABS and polystyrene, eager to gain a share of the more lucrative tailored-resins business. They are developing grades that can provide at least some of the properties stipulated for engineering plastics. And they are tailoring their efforts to win niches where classic engineering resins might be overengineered for a use.

Borg-Warner, for example, is developing modifications of ABS that can meet some engineering plastics demands. Its efforts are beginning to pay off, enough so that the company says that a significant share of the output from its new 150 million lb-per-year ABS plant nearing completion will go into the engineering resins market. Similarly, Dow, which already has decided to get into the business with its polycarbonates venture, is emphasizing performance plastics with polystyrene, and has some grades it is aiming at this market. As one marketer in commodity plastics puts it, "When plastics first came out, they got a bad name because they were underengineered. Then designers went wild and overengineered. Now, there is getting to be a healthier appreciation of the properties required for an application, and people can select the plastic that's appropriate." □

1981 sluggish for West German chemical firms

Although total sales were up almost 10% over 1980, prices barely kept up with inflation, production was up only slightly, and profitability was down

"It was not a glamorous year." That's how Herbert Grünewald summed up the position of the West German chemical industry in 1981 when he gave his first presidential address to the Verband der Chemischen Industrie (Chemical Industry Association) in Frankfurt recently. Grünewald, who is also chairman of the giant chemical firm Bayer, took over the association's presidency from Karl Wamsler, who completed his two-year term at the end of 1981.

In his state-of-the-industry message, Grünewald notes that chemical sales in West Germany last year approached $53 billion (based on a conversion rate of $1.00 = 2.24 Deutsche marks on Dec. 31, 1981), up 9.5% from 1980. On the other hand, sales of chemicals in West Germany produced by local companies rose only 5.1% to $31.2 billion. Moreover, profitability last year slipped to 1.5% of net returns from 1.8% in 1980 and from a relatively high 2.4% in 1979.

Grünewald: not a glamorous year

One reason for the worsening of profitability is the low level of the industry's plant utilization. For basic chemicals and petrochemicals generally, this now stands at 75% of capacity, a drop from 78% in 1980.

Another factor that influenced profitability adversely was the rise in feedstock and energy costs, which increased up to 50% last year for a large segment of the West German chemical industry. Despite the fairly stable 1981 price of oil and naphtha in U.S. dollar terms, the weakness of the Deutsche mark meant that West Germans had to pay considerably more for these items in their local currency much of the year.

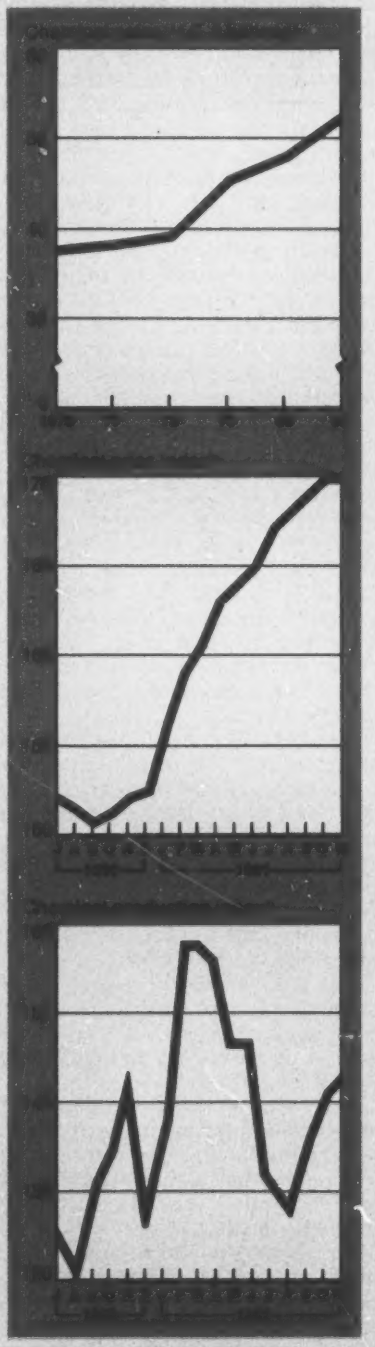
One advantage stemming from the weakness of the mark was that it served as a spur to chemical exports. These reached an all-time high of $24.2 billion, 14.3% greater than in 1980, and accounted for 45.8% of the chemical industry's total sales. Between 1976 and 1981, West Germany's chemical exports grew at an average annual rate of 9.4%, compared to a 6.8% average annual increase in total sales during the same period.

It was largely on the strength of exports that West Germany's chemical sales reached their 1981 level, Grünewald points out. Compared to 1980, exports to the U.K. were up 32%, to the U.S. 31%, to Japan 29%, and to France 10%.

Ironically, imports of chemicals into West Germany last year also increased to an all-time high. At $13.5 billion, imports last year exceeded those in 1980 by almost 14% and accounted for nearly 26% of total sales. Indeed, during the past five years, West German chemical imports have grown 11.6% annually, outpacing the growth rate of both exports and overall sales.

The two basic parameters of the industry—production index and price index—also point up the flat state of the West German chemical economy. Between January and November last year (December's figures haven't been reported yet), the production index averaged 144 (1970 = 100). That was a mere 1.6% improvement on 1980 during the like

West German sales, prices up; production is wavering



a $1.00=2.24 Deutsche marks as of Dec. 31, 1981.
b Base year for index is 1970=100.

period. The advance in the monthly price index was larger. But the 8.4% gain in 1981 barely kept ahead of inflation.

Not all segments of West Germany's chemical industry have their backs to the wall, however. Pharmaceuticals, pesticides, and other specialty products still demonstrate growth and profitability, Grünewald notes.

Those areas that have undergone the greatest decline for the most part are chemicals that are highly dependent on oil as feedstock. Commodity thermoplastics, for instance, have experienced sharp falls in selling price and output, largely because of intense competition in the marketplace, and are causing a severe financial drain on producers. Manmade fibers, too, still are experiencing trouble, despite the major production restructuring that companies have been working on for the past few years. Other classes of products that are going through a weak spell are fertilizers and photochemicals.

Despite all this, the chemical labor force has remained remarkably stable. Last year, the total declined a mere 0.5% to 548,000. "Our aim has been not to cut the number of workers," Grünewald says. "We stress short-time working instead."

Still, relatively few workers are on short time. In December, they amounted to 5500, about 1% of the total. Nevertheless, that was some three times greater than the number last August.

For 1982, Grünewald believes that chemical industry capital spending will decline from last year's $3 billion or so, which equaled the amount spent in 1980. Asked about sales and earnings for this year, he responds that much will depend on how the economy develops, not only in West Germany, but in the other leading industrialized countries.

It's still too early to predict the outcome of next spring's wage and benefits negotiations with the unions. Last year's direct pay settlement was 5.5% ahead of 1980.

But of one thing Grünewald is certain. Because his industry is 80% dependent on oil, there will continue to be a gap between costs and profits. "We must seek product price increases in 1982," he says, "to cover our higher costs and to improve our profit structure." He acknowledges that this won't be easy because of competition and resistance by customers who find it difficult to pass on higher prices.

Dermot O'Sullivan, London

CHECKOFF

■**Brazil**—Ultramold Resinas Sinteticas will build plant for production of amino plastics in Camacari, near Salvador, Bahia; cost and capacity have not been disclosed. Ultramold Resinas Sinteticas, new joint venture of Perstorp of Sweden and Ultra Enpreendimentos e Participacoes, the Brazilian Petrochemical Group, was established for production and sales of amino plastics. New plant, using Perstorp technology, is scheduled to be completed in 1983.

■**Canada**—Federated Cooperative Ltd. and Saskatchewan government will build $7.1 million (Canadian) pilot fermentation ethanol research plant at Canora to have annual capacity of 2.5 million gal of ethanol made from barley.

Liquid Air Corp. has formed new industrial gas company called Liquid Air Energy Corp., which will operate through Liquid Air's Canadian subsidiary, Canadian Liquid Air Ltd. Headquartered in Calgary, new company will serve energy-related industries with construction and engineering of cryogenic plants, industrial gas application technology, and supply of industrial gases.

PPG Industries has completed $20 million plant expansion that more than doubles sodium chlorate capacity at company's Stanchem chemical complex in Beauharnois, Que. Expansion adds 38,000 tons of annual capacity, bringing total at site to 73,000 tons per year.

■**Chile**—Sociedad Chilena de Litio will invest $61 million in project in Salar de Atacana region to produce 14 million lb per year of lithium carbonate. Company is 55% owned by Foote Mineral and 45% owned by Corporacion de Fomento de la Produccion of Chile. Fluor Mining & Metals, Redwood City, Calif., will perform engineering, procurement, and construction-management for project.

■**China**—Jacobs Engineering has been awarded contract for feasibility study for two facilities to recover total of 1.2 million tons per year of potash from brine of Chaerhan Lake, a dry lake 2500 miles west of Beijing, in Qinghai province.

■**West Germany**—Catalytic Inc. of Philadelphia has completed chlor-alkali plant at VEB Chemiekombinat in Bitterfield; new plant uses 104 electrolytic cells to provide capacity for 372 metric tons per day of chlorine and 419 metric tons per day of caustic soda. Technology licensed from Diamond Shamrock.

■**Japan**—Du Pont has signed letter of intent with Toray Industries to form venture to produce and market Hytrel polyester elastomer in Japan; marketing will begin early this year. Set up as new division of Toyo Products Co., a joint venture between Du Pont and Toray, new venture is planning plant to make Hytrel by mid-1983.

■**Mexico**—Jacobs Engineering will provide basic engineering, procurement, supervision of detailed engineering, personnel training, and startup assistance for estimated $25 million potassium chloride recovery facility to be built at Cerro Prieto in state of Baha California Norte. Plant, which will be built for Fertilizantes Mexicanos, will recover potassium chloride from residual brines discharged from geothermal electric generating station.

Polycyd has completed 150 million lb-per-year polyvinyl chloride plant near Tampico. This is Polycyd's second PVC operation, other being at La Presna, near Mexico City. Polycyd is joint venture of B. F. Goodrich and CIDSA group of Monterrey.

■**Portugal**—Quimigal has put on stream 10,000 ton-per-year polyether polyol plant at its industrial complex at Barreiro, near Lisbon; plant was designed and supervised by Petrocarbon Developments Ltd. based on Diamond Shamrock technology.

■**Venezuela**—Fluor will perform $2 million feasibility study for proposed petrochemical complex in Eastern Venezuela, close to Barcelona; if built by Petroleos de Venezuela, complex would use feedstocks from existing refineries and gas plants as well as from facilities yet to be built.